# Climate change and population declines in a long-distance migratory bird

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**Supplementary information by *Both* et al: Climate change and population declines in a long-distance migratory bird**

Table 1A: characteristics of the nest box study areas and the pied flycatcher populations using the nest boxes in the ten areas in the Netherlands that were used in the analyses.

| Area | Data collector[1] | Longitude | Latitude | Number of nest boxes | Caterpillar peak date[2] | Prop. of Great Tit Second broods[3] | Maximum number of pairs[4] | Population trend[5] (Slope ± SE) | | Proportional population change | Effect of temperature on laying date[6] (Slope + SE) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Buunderkamp | NIOO-KNAW | 05º 45' E | 52º 01' N | 260 | 57.5 | 0.12 | 93 | -0.0284 | 0.005 | -64% | -1.309 | 0.34 |
| Deelerwoud | Dekhuijzen | 05º 55' E | 52º 05' N | 200 | 57.5 | | 110 | -0.0025 | 0.004 | -9% | -1.827 | 0.27 |
| Ginkel | Stel & Van Laar | 05º 45' E | 52º 04' N | 240 | 57.5 | 0.33 | 106 | 0.0052 | 0.003 | +21% | | |
| Hoge Veluwe | NIOO-KNAW | 05º 51' E | 52º 02' N | 370 | 51.5 | 0.22 | 125 | -0.0071 | 0.003 | -23% | -1.929 | 0.32 |
| Keppel | VWG Doesburg | 06º 13' E | 52º 00' N | 54 | 37.5 | | 11 | -0.062 | 0.01 | -90% | | |
| Liesbos | NIOO-KNAW | 04º 40' E | 51º 35' N | 102 | | 0.07 | 9 | -0.060 | 0.01 | -89% | -0.41 | 0.57 |
| Oldhorst | Vd Brink | 05º 57' E | 52º 27' N | 84 | 39.5 | | 26 | -0.057 | 0.013 | -88% | -0.806 | 0.38 |
| Op de Bergen | Vd Brink | 05º 50' E | 52º 24' N | 39 | 58.0 | | 15 | 0.0035 | 0.003 | +14% | | |
| Staphorst | VWG Staphorst | 06º 17' E | 52º 37' N | 1435 | 52.8 | 0.32 | 356 | -0.0035 | 0.003 | -12% | -1.672 | 0.27 |
| Warnsborn | NIOO-KNAW | 05º 51' E | 52º 00' N | 80 | 44.5 | 0.10 | 29 | -0.0239 | 0.006 | -59% | -1.263 | 0.37 |

[1] Data were collected by the Netherlands Institute of Ecology (NIOO-KNAW), two local bird groups (Doesburg and Staphorst) and individual amateur bird researchers.

[2] Caterpillar peak date for each area is the mean of the peaks in 2003 for two trees expressed as days after 31 March. The peak dates of the two trees within the same area were correlated: $r_s$=0.74, n=9, p=0.02. Data were available for 9 of the 10 study populations.

[3] The proportion of great tits producing second broods in the years 1985-1990 (average of annual proportions). Second broods are laid after a successful first clutch has been raised, and thus prolong the breeding season.

[4] The maximum number of breeding pairs in the nest boxes in the period 1987 -2003. In Liesbos the decline started some years earlier than 1987, and in 1984 there were still 17 pairs breeding in the area.

[5] The slope (±SE) of the regression of the logarithm (to the base 10) of number of breeding pairs in nest boxes against year in 1987-2003.

[6] The slope (±SE) of the regression of the annual median laying date against temperature for the period 16 April – 15 May (+SD of the slope) for the period 1980-2002. Data were available for 6 of the 10 study populations.

**Justification for using caterpillar data from only 2003**

We have data for all 9 of the study populations on the caterpillar peak from only 2003. However, this value should be representative of the entire study period because:

(1) the timing of the caterpillar peak differs consistently among sites within the same forest: seven sampling sites on the Hoge Veluwe, for which we have data for 1993-2004 differ consistently in the date of peak caterpillar biomass (site: $F_{6,65} = 17.52$, $P < 0.001$ correcting for year: $F_{11,65} = 22.35$, $P < 0.001$; Visser,M.E., Holleman,L.J.M. & Gienapp,P., 2006 Oecologia In Press). The mean within year difference in caterpillar peak date between the earliest and latest site in this area is 9 days, which is about half the difference of 20 days between the sites used in this study.

(2) the timing of the caterpillar peak differs consistently among areas: three widely-separated (30-150 km) forests in the Netherlands (of which only one (HV) had breeding pied flycatchers, the other two sites are Vlieland (53.17˚ N, 5.03˚ E) and Oosterhout (51.55˚ N, 5.50˚ E)) for which we have data for differ consistently in the date of peak caterpillar biomass (area: $F_{2,12} = 3.90$, P=0.049; year: $F_{30,12} = 5.56$, P=0.0016).